Post-Las Conchas Fire Risk Results

High-level Summary with Supporting Information

June 19, 2012

1) Methods to assess risks were based on those developed post-Cerro Grande fire but were updated with more recent information from EPA and NMED
    a. Risks were evaluated compared to target level of 10^{-5} (1e-5) or 1 in 100,000
    b. Hazards were evaluated relative to the hazard index/quotient of 1.0
    c. Radiological dose was calculated but the dose results are not summarized in this document (no State target dose limits)
    d. Key analytes were identified based on calculating risks or hazards greater than these target levels

2) One of the sample results for strontium-90 in farm soil in 2011 (Table 1) was greater than values measured in 2000 (representing pre-fire conditions) or regional soil background and could represent a potential chronic health risk based on consuming produce grown in these fields. Average concentrations in Sile, NM were also greater than pre-fire levels. In addition, the thallium results from Sile, NM were greater than regional soil background concentrations (Table 1) and could also lead to chronic health risks based on the produce pathway. Other results for farm soil are discussed in #4.

3) Other media (sediment, stormwater, and fish) either do not represent health risks for the realistic scenario (recreational) or levels are not greater than pre-fire or background levels. Stormwater is not realistic as a chronic health risk but there are risks associated with rapidly rising water levels in canyons or rivers downstream of fire scars. There is an advisory for consuming fish in Cochiti Lake based on PCB and mercury concentrations. Additional information on the recreational risks is presented in #5, #6, and #7.

4) Evaluated risk for farmer-rancher exposures based on exposure to maximum measured concentrations in farm soil and estimated concentrations in crops and livestock
    a. See #1 for discussion of risks from strontium-90 and thallium.
    b. Radiological risks from farm soil are significant for potassium-40 and isotopic thorium, which are naturally occurring radionuclides. Post-fire risks for these radionuclides are bounded by pre-fire or background levels. Therefore, there is no difference in risk for these radionuclides as a result of the fire and deposits of ash laden sediment on farm fields (not fire related).
    c. Chemical risk for arsenic is significant but concentrations in post-fire soil are less than those measured in pre-fire soil. Therefore, no incremental risk above background (not fire related).

   d. Several metals may represent health risks in post-fire soil based on assumed uptake into produce but with exception of thallium the concentrations in post-fire soil are less than those measured in pre-fire soils (not fire related).

5) Evaluated risk for recreational exposures based on exposure to maximum measured concentrations in sediment
   a. Radiological risks from sediment are driven primarily by potassium-40, isotopic radium, and isotopic thorium that are naturally occurring radionuclides. Post-fire risks for these materials are bounded by the Pajarito Plateau sediment mean background and/or the upper tolerance limit (UTL) of sediment background. Therefore, there is no difference in risk for these radionuclides as a result of the fire and deposits of ash laden sediment.
   b. Radiological risk from sediment is significant (2E-5 risk) for cesium-137 and concentrations are statistically greater than Pajarito Plateau sediment background concentrations. Chronic risks are overestimated by evaluating the maximum concentration and not accounting for background exposures.
   c. Chemical risk for arsenic is significant but concentrations in post-fire sediments are basically equal to UTL of background for the Pajarito Plateau. Therefore, arsenic does not show a notable increase related to the fire.
   d. Chemical hazards are possible for thallium (HQ=1.2) but are due to the maximum concentration measured in suspended sediment (6.1 mg/kg). The maximum concentrations measured in sediment *in situ* (1.2 mg/kg) are less than two times than the upper Pajarito Plateau sediment UTL (0.73 mg/kg).

6) Evaluated risk for recreational exposures based on exposure to maximum measured concentrations in water
   a. Stormwater is not a chronic exposure medium.
   b. Key analytes for risk from stormwater were not considered to be fire related in the sediment risk evaluation (radium-228 and arsenic)
   c. Central tendency exposures to stormwater met target risk and hazard levels

7) Evaluated risk for recreational exposures based on exposure to maximum measured concentrations in fish
   a. There is a fish consumption advisory for Cochiti Lake. Limits are one or two 8-ounce fillets per month[1].
   b. Chemical risks are notable for arsenic. Concentrations of arsenic are greater in post-fire fish (0.22 mg/kg) than background levels (0.1 mg/kg).
   c. Chemical hazards are notable for mercury. Concentrations of mercury are greater in post-fire fish (1.7 mg/kg) than in pre-fire samples (1.3 mg/kg).
   d. Although target risk/hazards are exceeded for reasonable maximum exposures, the central tendency exposures met target levels.

[1] 2 8-ounce fillets per month would be about equal to the central tendency fish intake.

<u>Supporting information documenting concentrations of key analytes in soil and sediment.</u>

Table 1 presents the 2011 and 2012 farm soil concentrations for strontium-90 and thallium. Two high strontium-90 concentrations are highlighted for the Sile, NM fields. The average strontium-90 concentration at Sile, NM is 0.93 pCi/g, which is more than two times the regional soil background of 0.4 pCi/g. The maximum concentration of strontium-90 is eight times the regional background concentration. The thallium concentrations in 2012 are about 1000 times lower then those reported in 2011 samples. The regional soil background value for thallium is 0.24 mg/kg and the Pajarito Plateau soil background value is 0.73 mg/kg.

Figures 1-6 present comparisons of soil and sediment concentrations versus pre-fire or background concentrations. Boxes in these figures indicate the interquartile range of the sampling results, with the upper and lower ends defined by the 75th and 25th percentiles, respectively. These plots can be used to visually determine if there are significant increases in concentrations after the Las Conchas fire. Figures 1-3 show that concentrations after the fire are not greater than those before the fire or regional soil background concentrations. There is one exception that was noted above in the discussion of strontium-90 from the Sile, NM fields. Figures 4 and 6 show some increases in cesium-137 and strontium-90 in sediments (including muck) after the Las Conchas fire. Potassium-40 does not show an increase after the fire compared to background but the range of potassium-40 concentrations in 2011 and 2012 is less than reported in other years.

Table 1. Concentrations of Strontium-90 and thallium measured in Farm Soils in 2011 and 2012. Notable concentrations are highlighted in yellow.

		Strontium-90			Thallium	
Location	Date	Result	Unc.	Qual[1]	Result	Qual[2]
LowerPecos Field-1	4-Jan-12	0.18	0.13	U	0.00039	U
Upper Pecos Field-2	4-Jan-12	0.1	0.12	U	0.00036	U
Upper Pecos Field-2 DUP	4-Jan-12	0.077	0.12	U	--	--
Suina Field composite	16-Feb-12	0.078	0.13	U	0.00039	U
Top of Upper Field @ Sile	15-Dec-11	0.2	0.13	U	0.79	B
Bottom of Upper Field @ Sile	15-Dec-11	0.24	0.15	U	0.67	
Top of Lower Field @ Sile	15-Dec-11	3.2	0.78		0.67	B
Bottom of Lower Field @ Sile	15-Dec-11	0.074	0.12	U	1.1	B
Bottom of Lower Field @ Sile DUP	15-Dec-11	0.93	0.26		--	--

1 U = Result is less than the sample specific MDC
2 U = Not Detected at or above the client requested detection limit
2 B = Below reporting limit but above detection limit

Plots of key radionuclides in soil.

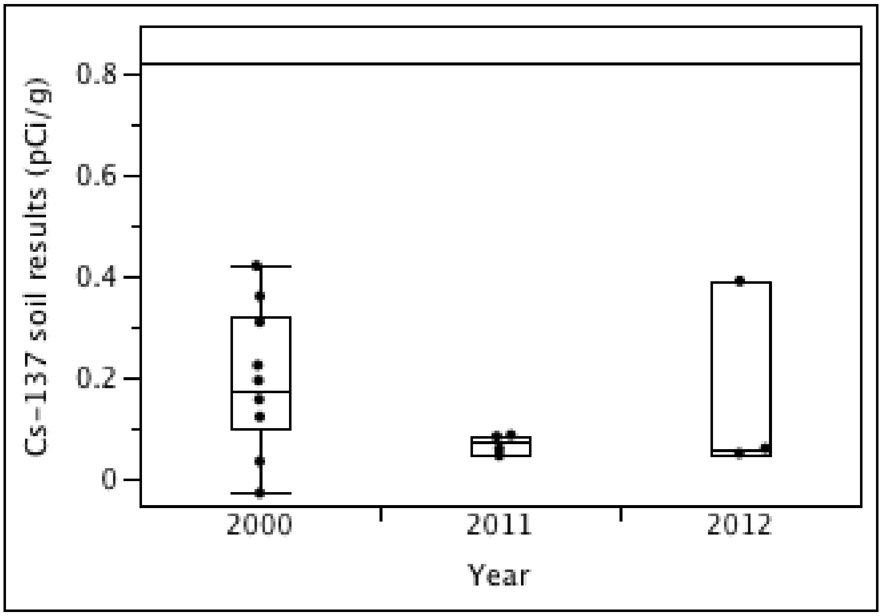

Figure 1. Cesium-137 (pCi/g) in farm soils in 2011/2012 (without duplicates) compared to 2000 levels and regional soil background (0.82 pCi/g mean plus 3 sigma as the solid line). There is no statistical difference between years (Kruskal-Wallis test, p=0.29).

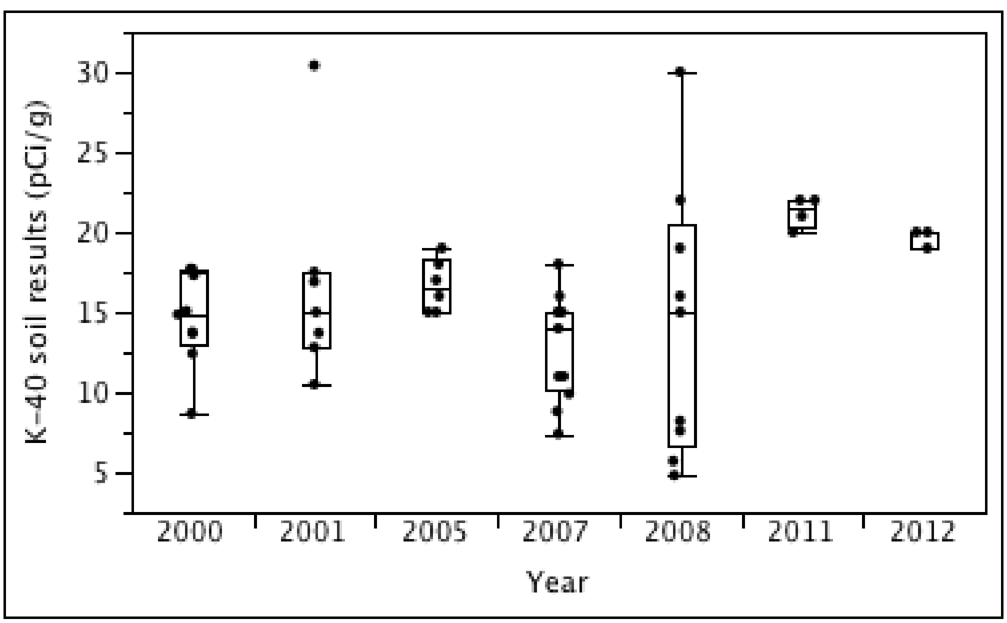

Figure 2. Potassium-40 (pCi/g) pre-fire soils compared to 2011 and 2012 results (without duplicates). There is a statistical difference between years (Kruskal-Wallis test, p<0.01).

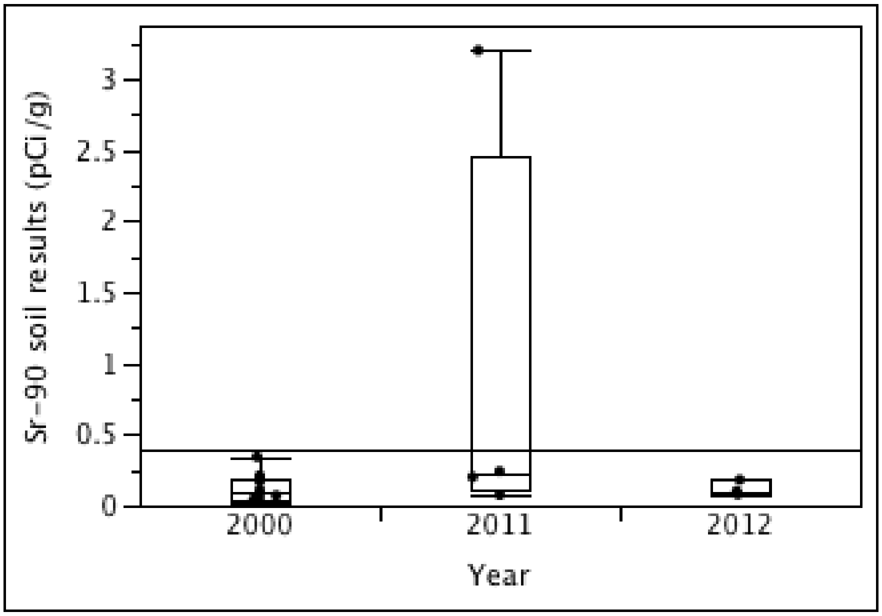

Figure 3. Strontium-90 (pCi/g) in farm soils in 2011/2012 (without duplicates) compared to 2000 levels and regional soil background (0.4 pCi/g mean plus 3 sigma as the solid line). There is no statistical difference between years (Kruskal-Wallis test, p=0.28).

Plots of key radionuclides in sediment.

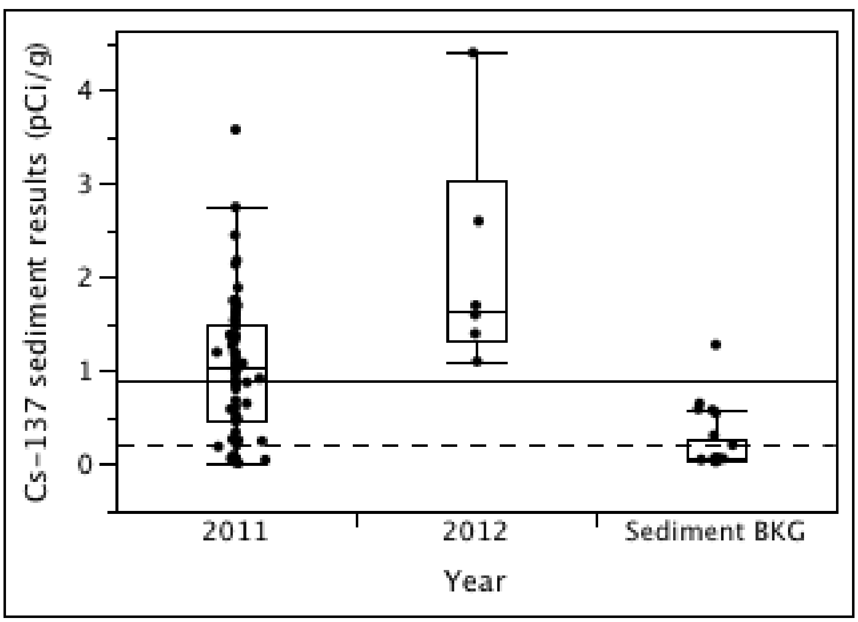

Figure 4. Cesium-137 (pCi/g) in 2011 and 2012 sediments (without duplicates) compared to Pajarito Plateau background concentrations (background mean is 0.211 pCi/g as the dashed line; background UTL is 0.9 pCi/g as the solid line). There is a statistical difference of 2011, 2012, and background (Kruskal-Wallis test, p<0.001).

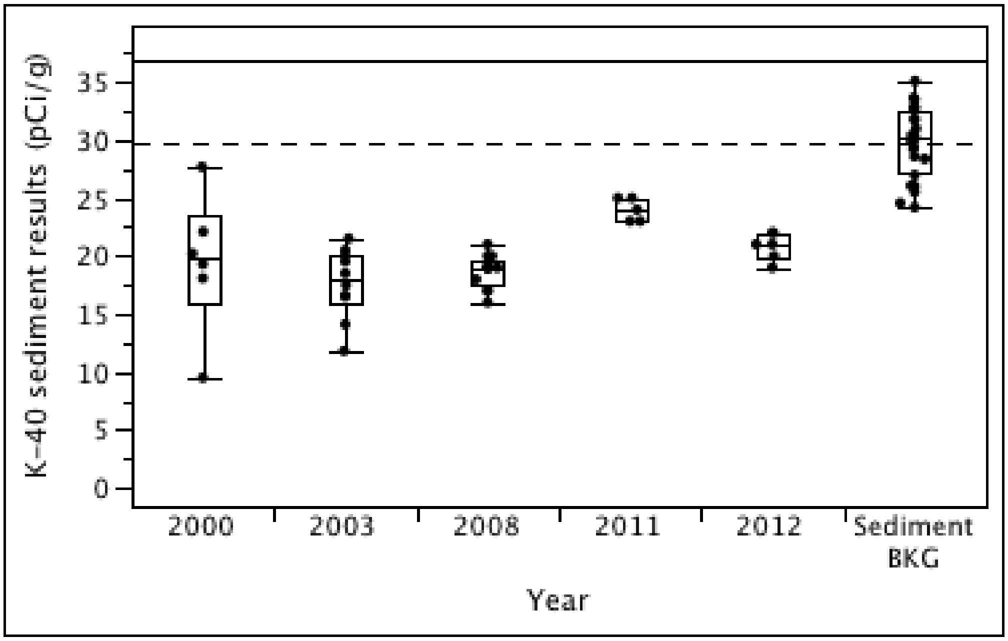

Figure 5. Potassium-40 (pCi/g) pre-fire sediments compared to 2011/2012 concentrations (without duplicates) and Pajarito Plateau background (background mean is 29.8 pCi/g as the dashed line; background UTL is 36.8 pCi/g as the solid line).

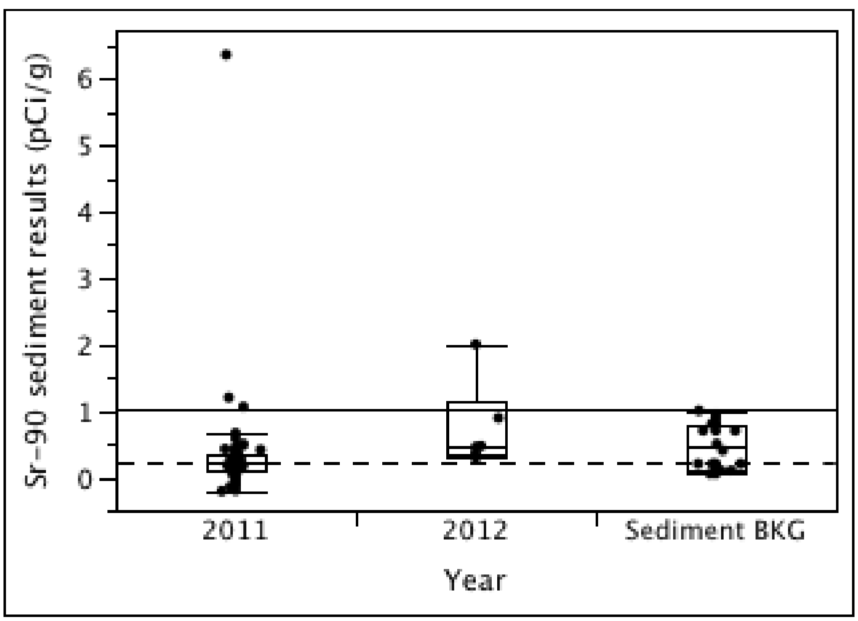

Figure 6. Strontium-90 (pCi/g) in 2011 and 2012 sediments (without duplicates) compared to Pajarito Plateau background concentrations (background mean is 0.229 pCi/g as the dashed line; background UTL is 1.04 pCi/g as the solid line). There is a statistical difference of 2011, 2012, and background (Kruskal-Wallis test, $p<0.01$).